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THE MANUFACTURE OF COTTAGE CHEESE

C. A. PHILLIPS[1]

Cottage cheese was probably the first type of cheese manufactured, milk that had been soured or clabbered naturally in the home being used. In recent years the product has been manufactured on a large scale with improved equipment in dairy manufacturing plants. The recent development probably results from increased knowledge of the food value of cottage cheese and additional information on methods of manufacture.

The volume of cottage cheese manufactured in California has increased very rapidly during the past few years until the year 1929 when there was a slight decrease. The quantities manufactured in recent years as given in the statistical reports of the California State Department of Agriculture are as follows:

Year	*Amount manufactured, pounds*
1925	10,051,863
1926	11,073,000
1927	13,504,228
1928	18,672,704
1929	17,717,809

SELECTION AND QUALITY OF MILK

Milk of good quality is necessary for the manufacture of uniform cheese which will "stand up" on the market. The acidity must be low, preferably not above 0.18 per cent when delivered by the patron. The chief requisites in producing milk of low acidity are the proper sterilization of equipment and the cooling of milk immediately after milking. Many times milk with high acidity is received at the factory and is separated, or skim milk is held too long before pasteurization, so that acid is permitted to develop. In some cases it has been the practice to reduce the acidity in the skim milk by using alkalies, as in cream for buttermaking. This procedure cannot be recommended, for it is impossible to make a high quality cheese from sour milk by reducing the acidity.

The milk should also have a good flavor and odor. There is danger that feed or weed flavors, especially, may be carried over into the finished product. The bacterial count should be low, although this may not always be so important as the types of bacteria present.

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PASTEURIZATION OF THE SKIM MILK

After separation, the skim milk should be pasteurized as soon as possible by the holding method—140° to 145° Fahr. for 30 minutes, or by the flash method—176° to 185° F for a few seconds. It should then be cooled to the setting temperature as soon as possible. Efficient pasteurization, in addition to destroying approximately 99 per cent of the total number of bacteria, destroys the disease-producing bacteria, should any be present. *Pasteurization of the skim milk is absolutely essential for the factory production of cottage cheese of uniform quality, and is required by the California State Dairy Laws.*

There is some disagreement as to which method of pasteurization is preferable, even taking into consideration that the efficiency in destruction of bacteria is the same in both cases. The holding method is probably the better for plants with small output, while the flash method—preferably the regenerative system—is more economical in large scale production.

PROPAGATION OF STARTERS

In cheesemaking, a starter may be defined as a culture of milk with the lactic-acid-forming bacteria predominating. A good starter is necessary in the manufacture of cottage cheese. The culture for beginning the propagation of the mother starter may be obtained from any one of several reliable laboratories. Both liquid and powder cultures are on the market; either may be used successfully.

Several clean, sterile quart bottles are filled about three-fourths full of fresh, clean whole or skim milk, preferably pasteurized. These are heated in a water bath to a temperature of from 180° to 190° F for one hour or more, or in an autoclave under 15 pounds steam pressure for 20 or 30 minutes, and then cooled to 80° F. They should be inoculated with the culture at this temperature late in the afternoon, and incubated overnight at the inoculation temperature. An electric incubator may be purchased, or a wooden box, fitted with a rheostat and electric light, may be constructed. Some cheese makers place the bottles near the boiler, or in a warm room. This method, which is unreliable because the temperature may fluctuate, may be greatly improved by placing the bottles in a water bath at the incubation temperature.

A smooth coagulation of the milk should be obtained by the following morning. The bottles should then be placed in a cold room at a

temperature below 40° F or in an ice box until used. This mother starter is carried forward the second and succeeding days. The procedure outlined above is followed, except that inoculations are made from a small amount of the mother starter, prepared the previous day, and incubations are made at a temperature of 70° F.

The quantity of milk needed for the bulk starter is selected and pasteurized in a starter can, or in 10-gallon cans at a temperature of 180° or 190° F for one hour. It is then cooled to 70° F and inoculated with the mother starter. The amount necessary depends on the strength of the mother starter, the temperature of incubation, and the initial acidity of the milk. When the milk is held at a constant temperature of 70° F, about 1.0 per cent of mother starter will be required. The starter should have a clean acid flavor, with 0.65 to 0.90 per cent acidity, be free from objectionable gas formation, show no whey separation on top, and be smooth and creamy after thorough agitation. Low acid starters have also been used by some manufacturers with varying degrees of success.

METHOD OF MANUFACTURE

Equipment.—In addition to the equipment for receiving and pasteurizing milk and for making starter, the following apparatus is necessary for the manufacture of cheese: cheese vats (fig. 1), curd knives, acidity test apparatus, wooden paddles, strainers, curd racks, curd buckets, and scales. Larger manufacturers employ mechanical means in mixing and packaging.

The amount of cheese to be manufactured will determine the amount of equipment necessary. Whether it is made in the home, in the farm milk house, or in the factory, the principles are the same; and suitable equipment may be purchased from any reliable dairy machinery and supply company.

Adding the Starter, Color, and Rennet (Setting).—From 0.15 to 5.0 per cent of starter is added to the skim milk, depending upon the activity of the starter, the acidity of the skim milk, the setting temperature, and the time allowed for coagulation. This last will vary to suit working hours. The addition of a small percentage of starter might result in too few lactic-acid-forming bacteria being present, although the University Farm Creamery for several years has experienced excellent results in using 0.15 per cent starter. The use of too much starter is likely to result in the formation of a soft coagulation.

Harmless coloring matter is permitted by the California State Dairy laws and may be added at the rate of one or two milliliters (1 or 2 cubic centimeters) for each 1000 pounds of skim milk. This amount changes the appearance of the finished product from a chalky white to the light cream color desired by some markets. The excessive use of coloring matter is not to be recommended. The Food, Drug, and Insecticide Administration of the Department of Agriculture at Washington, D. C., has ruled the use of coloring in cottage cheese illegal, but its scope of control covers interstate shipments only. Its

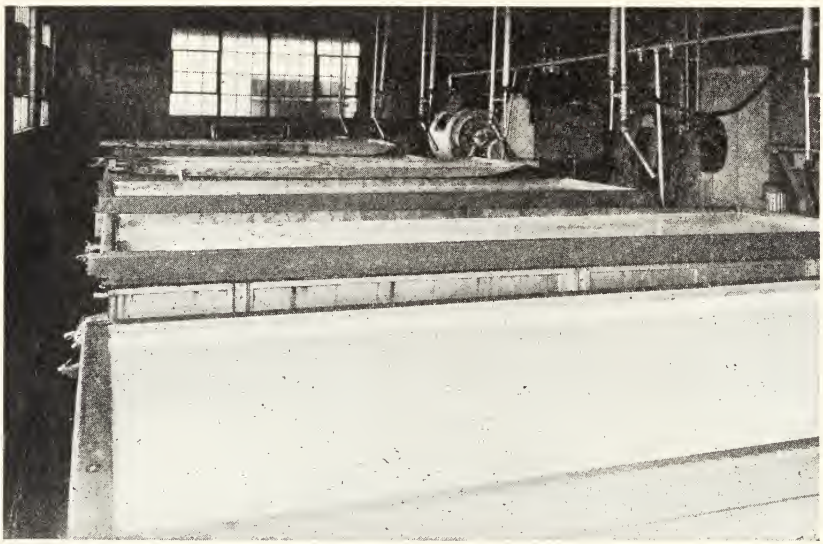


Fig. 1.—Large cheese vats are filled with skim milk.

ruling is, therefore, of minor importance on the Pacific Coast, for very little cottage cheese is shipped from one state to another.

Two types of cottage curds are manufactured; one the acid curd without the use of rennet, and the other the rennet curd. The use of rennet is recommended when the skim milk is pasteurized by the flash method and cooled immediately. The amount of rennet necessary depends upon its strength, but with the best quality 0.5 cc to 1.5 cc for each 1000 pounds of skim milk should be sufficient. The use of excessive amounts of rennet has been a common mistake since its introduction into cottage cheese manufacture.

With the flash system of pasteurization, unless a small amount of rennet is used, the curd breaks up during heating, giving a fine-grained cheese instead of the coarse, flaky product common in western mar-

kets. In the case of pasteurization by the holding method, rennet may be used, but it is not necessary in order to obtain a coarse, flaky curd.

When the flash system is used, a small amount of a solution of calcium chloride is sometimes added to the skim milk to aid in obtaining the proper coagulation. This addition may be beneficial, for a part of the calcium salts may be precipitated or rendered less active during the pasteurization process.

Cutting the Curd.—The firmness of the curd can be observed by pressing it with the hand or by inserting the index finger or a floating thermometer into the curd diagonally and then raising it slowly, breaking the curd. It is difficult, however, to gauge the coagulation from day to day when such methods are employed.

A more uniform product may be obtained when the curd is cut according to a definite titratable acidity or hydrogen ion concentration of the whey at the time of cutting. A sample for this purpose may be obtained by inserting a strainer in the vat of curd a short time before coagulation is complete in order that the whey may be allowed to seep through.

In the acid curd method of manufacture at the University Farm Creamery the proper titratable acidity of the whey at the time of cutting has been found to be 0.55 per cent. The hydrogen ion concentration on the same samples varied between pH values of 4.29 to 4.37, the acidity having been carried beyond the isoelectric point of casein (pH 4.7).

Cutting may be done with knives similar to cheddar knives with the wires three-quarter inch to one inch apart: first, lengthwise of the vat with the horizontal knife, then lengthwise and crosswise with the vertical knife. In cutting, care should be taken to obtain cubes uniform in size. If this is not done, difficulty is encountered in heating, for the moisture is expelled at a different rate from cubes of different sizes.

Heating the Curd.—After cutting, the jacket of the vat is filled with warm water in case it was not allowed to remain full during the coagulation period. The steam valve is then opened, and a small amount of steam is allowed to flow into the jacket. The temperature in the vat must be raised slowly in order to prevent a too rapid firming of the curd. During heating the curd should be agitated slowly within a wooden paddle to prevent matting. Heating and agitating the curd slowly during the first hour is one of the most important steps in obtaining large, flaky particles with smooth, even texture.

Excessive agitation should not be practiced or the curd will be broken up into small particles.

After the steam has been allowed to flow slowly for a period of two to three hours, depending upon the size of vat, the temperature of the curd should be 115° F to 130° F. There is no definite rule on the maximum temperature, however, as vats of curd are not alike from day to day. The temperature should be varied according to the conditions, which must be judged by the operator. When the proper temperature has been reached, the steam should then be turned off and the water drawn from the jacket.

Drawing the Whey (Dipping).—As soon as the curd is firmed properly at the heating temperature desired, the large gate is opened, and the whey is drawn as quickly as possible. No definite rule or test can be applied as to the proper firmness of the curd; this knowledge must be gained by experience. Some cheesemakers dip a handful of curd into cold water and observe its consistency after cooling. Regardless of the method used in determining when to draw the whey, time for draining must be considered, so that the curd will not become too firm.

Washing the Curd.—The curd is washed with cold water as soon as the whey is drawn. One method is to run pure cold water into the vat containing the curd. This serves to cool it immediately and reduces the acidity. With this practice, two or more washings are necessary in order to produce mild-flavored cottage cheese. The temperature of the wash water is sometimes varied, each successive volume of water being colder than the preceding one. A small amount of neutralizer is sometimes added to the last wash water in order to produce a cottage cheese with lower acid content.

Another method commonly used is to draw the curd and whey on to screen racks covered with a coarse mesh cloth. The curd is then washed on these racks by spraying cold water over it from a perforated pipe.

Precooled water should be used in this method of washing cottage curd, for it facilitates the reduction in temperature. A supply of cold water may be maintained by building a storage tank containing ammonia expansion coils. The tank should be on a higher level than the vat or racks in order that the water may flow by gravity. After washing, the cheese is transported to a storage room, or may be further processed in the vat.

Salting the Curd.—In case the curd is washed in the vat, the last wash water is allowed to drain off thoroughly by trenching the curd

(fig. 2). The curd is then spread over the bottom of the vat, and salt is applied in two or three applications, each addition being stirred in. The amount of salt added depends upon the market demands and usually varies from ¾ pound to 1½ pounds salt for each 100 pounds of curd.

The greater amount of the cottage cheese manufactured in California is made in the central valleys where there is an available supply of skim milk. It is then shipped to the cities in large cans for further processing and packaging before distribution. In such cases the curd may be washed again and salt added before creaming in the city plant.

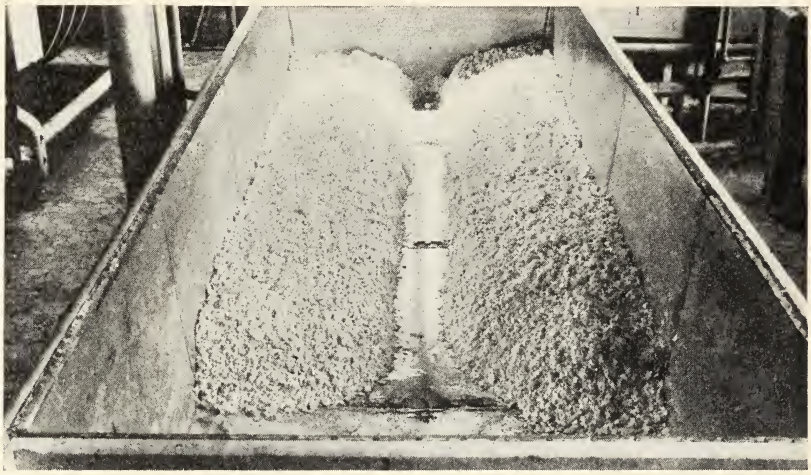


Fig. 2.—Trenching and draining the curd in the vat as practiced at the University Farm Creamery.

The curd should be salted as soon as possible after manufacture, for the preservative action of salt aids in the keeping of the cheese.

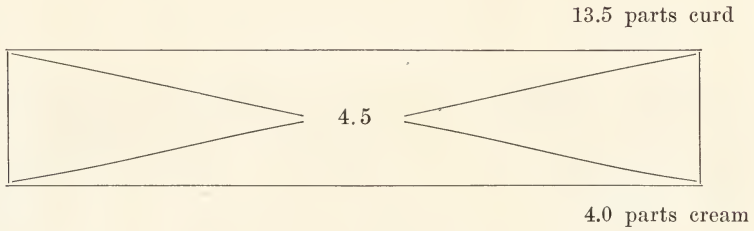
Creaming the Curd.—The California Dairy Laws of 1929 read: "Cottage cheese shall be made from pure milk or skim milk which has been pasteurized by the system described for market milk or by the system described for manufacturing milk or cream, with or without harmless coloring matter, and sold fresh without molding into forms. Creamed cottage cheese is cottage cheese to which a sufficient quantity of pure, fresh, pasteurized sweet cream is added so that the finished product contains not less than four per cent of pure milk fat."

While the uncreamed cheese usually contains about 0.50 per cent butterfat, this will vary, depending upon the efficiency of the separator in skimming the whole milk. Enough butterfat must be added to meet the State requirement of four per cent in the finished product. The

amount of cream to be added may be calculated by the "Pearson square" method:

Problem: How much cream containing 18 per cent butterfat must be added to 100 pounds of curd in order to obtain a creamed cottage cheese containing 4.5 per cent butterfat?

The tests of the curd and cream are placed at the left hand corners of the rectangle and the test desired in the center. Subtractions are made diagonally across the rectangle.



The calculation is completed as follows:

13.5 parts = 100 pounds
1.0 parts = 7.42 pounds
4.0 parts = 29.64 pounds amount of cream to be added.

The per cent of butterfat desired in the finished product will depend upon the particular market to be supplied, and in some places the fat content runs as high as seven per cent. The cream to be added to the curd varies in butterfat content from 25 per cent down to a mixture containing about 12 per cent butterfat. When the curd is moist and soft a richer cream should be used. The mixture containing low butterfat may be added to a dry, firm curd, especially where the curd has been pressed in order to eliminate as much water as possible. In either case the cream added must be of high quality, for it affects the keeping quality of the finished product to a great extent. Proper pasteurization of the cream will destroy yeasts and molds, which are detrimental.

The cream may be mixed with the curd in the vat in small scale production. When the output justifies the expenditure, however, the cream and curd are mixed in a large cottage cheese mixer (fig. 3).

Some gelatin manufacturers and research workers have recommended the addition of gelatin to the cream before adding it to the curd, claiming that it prevents wheying off and that it gives the cheese a more creamy appearance. The California State Dairy Law, however, does not permit the use of gelatin in cream for cottage cheese.

Packaging the Cheese.—After creaming, the cottage cheese is scooped into containers or is transferred to a hopper with an opening

Fig. 3.—Mixing the cottage cheese and cream in a mechanical mixer.

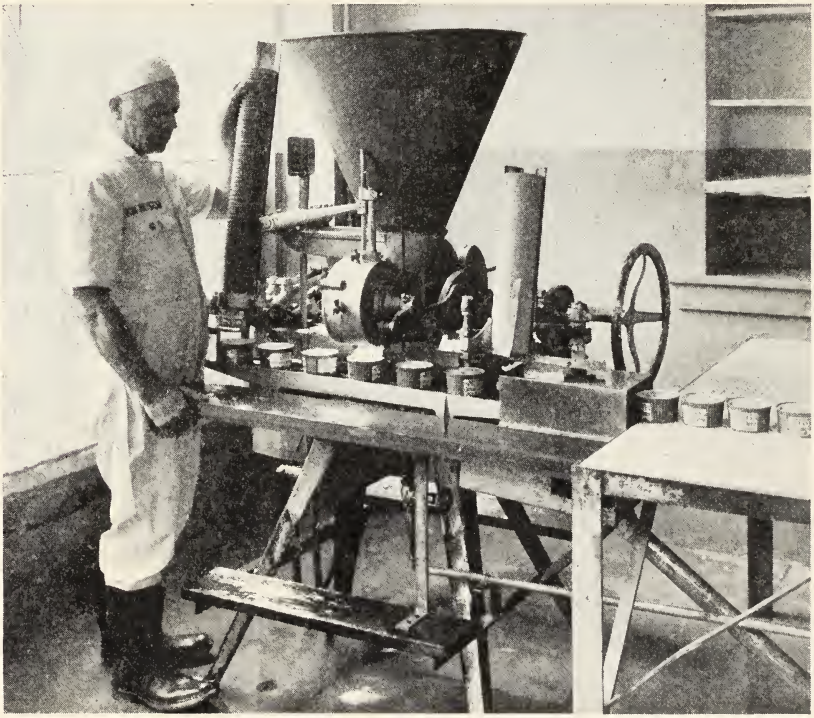


Fig. 4.—Packaging the cheese in paraffined cartons.

of the proper size for packaging (fig. 4). The cheese is delivered or shipped to the stores in a number of different styles of containers, including milk cans, tin pails, cardboard cartons, and wooden boxes. A standard form of package for the consumer is the paraffined carton containing six to twelve ounces, although some stores use the carrier carton, the cheese being ladled from bulk by the dealer.

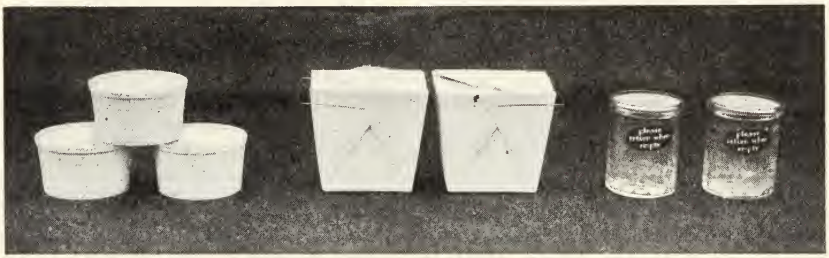


Fig. 5.—Retail packages: Left, paraffined carton; center, carrier carton; right, glass jar.

Glass containers have also been used, sometimes being filled under partial vacuum. These are more expensive than paper, and the usual procedure is to deliver and return them on retail milk wagons. Criticisms have been made of their use in retail store distribution because the usual "wheying-off" of liquid which may be observed through the glass is not pleasing to the eye.

Yield.—The yield of cottage cheese will vary from 13 pounds to 19 pounds for each 100 pounds of skim milk, depending upon the solids content of the skim milk, the amount of moisture retained in the cheese, and mechanical losses during the manufacturing process. The solids content of skim milk will vary from 8.3 per cent to 9.5 per cent; the higher the solids content, the greater will be the yield. The moisture content will vary from 65 per cent to 85 per cent. With careful procedure in manufacture, mechanical losses should be low, although, if the operator is careless, they may be so great as to decrease the yield.

DEFECTS IN COTTAGE CHEESE

The following score card is recommended for cottage cheese:

COTTAGE CHEESE SCORE CARD

Name of Cheese Factory..... *Post Office*.....

No..... *Date*..... *Scored by*.....

	Scale	Score	
Flavor.....	50		
Texture.....	30		
Appearance.....	10		
Salt.....	5		
Package.....	5		
Total.....	100		Moisture.....%. Fat.....%.

The defects commonly found in flavor of cottage cheese are: acid, flat, yeasty, feed taint, metallic, stale, old cream, bitter, and unclean.

Acid flavor is usually due to the development of too much acidity during the coagulation period, improper coagulation and firming of the curd, or to insufficient washing. Excessive moisture content and exposure to warm temperature may also cause this defect, since milk sugar is in solution in the water and is changed to lactic acid by the bacteria present.

Flat flavor, caused by lack of development of acidity, or by the use of rennet extract, is a defect in but few localities. The people in the large cities on the Pacific Coast have been educated to prefer this type of cheese.

Yeasty flavor results from yeast organisms in the cheese. Inefficient pasteurization, contamination from equipment, and yeasty cream usually account for this defect.

Feed flavors are caused by the cows eating green feed before milking. Weeds, such as wild onion or garlic, are also very detrimental.

Metallic flavor is usually due to the milk coming in contact with certain metals, copper and its alloys probably being the most objection-

able. Old cheese vats, rusty milk cans, or other equipment may be responsible for this defect.

Old cream added in the creaming process causes an off flavor, or it may cause yeasty, feed, metallic, stale, bitter flavors if they are present in the cream.

Stale flavor will develop as the cheese ages, depending upon the quality of the original milk and cream, and upon the types of bacteria present.

Bitter flavors are usually due to bacterial action.

Unclean flavors result from the use of poor starter, or from bacterial action caused by contamination by equipment.

The requirements on texture of cottage cheese vary in different sections of the country. The Pacific Coast markets seem to prefer the large, coarse, flaky particles of curd manufactured by the rennet method, while most other sections have preferred a finer grained product such as that manufactured by the acid process. Regardless of the type manufactured, the texture should be smooth.

The most common defects in texture, with the exception of the size of the curd particles, are graininess, rubberiness, dryness, stickiness and wateriness.

Graininess results from uneven heating of the curd caused by heating too rapidly or too high, insufficient agitation allowing the curd to "cook" on the sides of the vat, uneven cutting, or breaking the curd into particles of different sizes. Flash pasteurization of the skim milk also has a tendency to produce a fine grainy cheese unless a small amount of rennet is added to aid in obtaining a coagulation.

Rubbery texture is caused by using too much rennet or by failure to develop the proper acidity during the coagulation period. The effect of heat on such curd aids in causing the defect.

Dry cottage cheese is too low in moisture and is caused by excessive heating, or by the addition of too little cream or of cream too high in fat content.

Sticky cheese is caused by improper mixture of curd and cream, by the use of too much rennet, or by too slow cooking.

Watery cheese is caused by wheying off, which results from the improper use of cream, or it is caused by exposure of cheese to warm temperatures.

In certain lines of industry the present period has been termed an "age of color." The ideal color of cottage cheese should be a creamy yellow tinge, obtained by adding a small amount of cheese color to

the skim milk. Cheese defective in color may be chalky or too light, too high, uneven, or it may contain color specks.

Chalky or too light color results from the use of too little or no color. This defect varies with the amount of color pigment in the serum.

Too high color is caused by the use of excessive amounts of coloring. Color should not be used to attempt to make the consumers believe that the cheese is rich in butterfat.

Uneven color is caused by mixing curd and cream which are different in color and by the failure of the curd to absorb the cream properly.

Color specks result from the addition of cheese color which has precipitated, probably because of freezing or standing a long period of time.

Defects in saltiness are rarely found, for the salt content may vary considerably. Too much salt is objectionable, but too little is not, for the consumer may add salt to suit the taste.

The package is important, in marketing, and should be substantial, clean, tidy, well filled, and easy to empty.

MARKETING

At the present time the marketing of cottage cheese is receiving much attention. Cottage cheese companies should organize and maintain a sales department equal in importance to the production department, with an experienced man in charge.

Information should be obtained which will aid in increasing the business profitably. The tendency today is to give the buying public what they want, when and where they want it; and this should be the chief aim of the sales department. Methods of distribution, cost of distribution to the dealer and consumer, types and sizes of packages, the problem of returned cheese, variations in consumption at different times of the year, and many other problems should be studied.

Cottage cheese is sold to the consumer by the milk wagon salesman and by various dealers, chiefly delicatessen stores, meat markets, and grocery concerns. Cottage cheese must be kept in a cool place, protected from contamination, and should be presented in a manner attractive to the purchaser. In the case of bulk cottage cheese, a suitable container must be kept by the dealer; and the sales department must inform him regarding the proper methods of handling the product.

STORAGE

Cottage cheese is best when sold fresh. In case of surplus, however, it is possible "that cottage cheese may be held frozen in cold storage for several months and come out in condition satisfactory for food and market purposes."[3] The curd should be pressed to eliminate as much water as possible before storing.

STEPS IN THE MANUFACTURE OF COTTAGE CHEESE

Acid Curd Method.

1. Pasteurize skim milk at 142° F, hold for 30 minutes, and then cool to 78° F.
2. Add from 0.15 per cent to 5.0 per cent starter, depending upon activity of the starter, etc. Add color if desirable.
3. After proper coagulation is obtained, cut three ways with coarse wire curd knives, obtaining uniform cubes.
4. Heat the curd gradually with a minimum amount of agitation to a temperature of 115° to 130° F until proper firmness is obtained. Draw the whey.
5. Wash the curd with cold water in the vat or on curd racks.
6. Add salt, ¾ pound to 1½ pounds for each 100 pounds of curd.
7. Add cream in order to increase the butterfat content to the 4 per cent minimum or higher.

Rennet Curd Method.

1. Pasteurize skim milk at 176° F to 185° F and cool immediately to the setting temperature, about 72° F.
2. Add one to five per cent starter, depending upon the activity of the starter, etc. Add color if desirable.
3. Add ½ to 1½ cc rennet (diluted in cold water 1 to 40) for each 1000 pounds of skim milk.
4. The remaining steps are the same as in the acid curd process.

ACKNOWLEDGMENT

Acknowledgment is made of the assistance of the Knudsen Creamery Company, Los Angeles, in supplying illustrations and offering suggestions, and to the members of the Dairy Industry Division and others who aided in the preparation of the manuscript.

[3] Ellenberger, H. B. Cold storage of cottage and other soft curd cheeses. Vermont Agr. Exp. Sta. Bul. 213:1–23. 1919.

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